

Fourth Annual Conference on Carbon Capture & Sequestration

*Developing Potential Paths Forward Based on the
Knowledge, Science and Experience to Date*

Regulatory Analysis Session

Regulatory Considerations for Geologic Sequestration of Carbon Dioxide

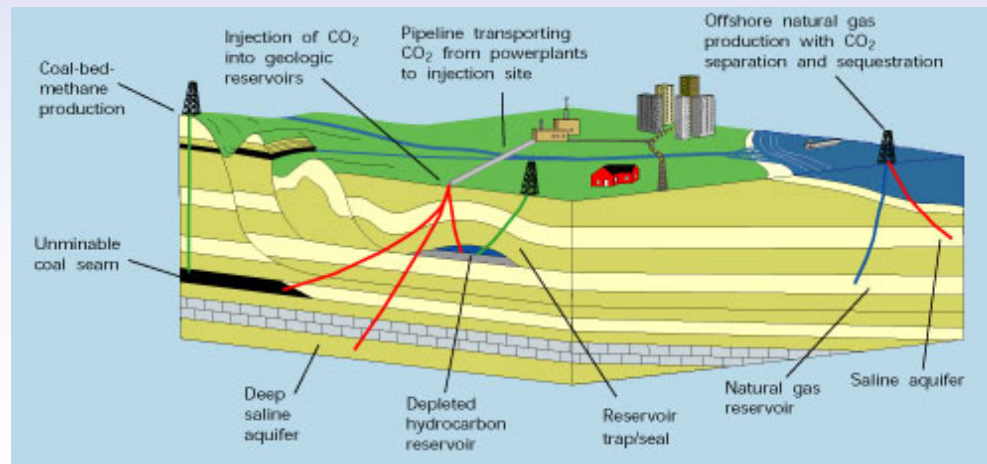
Michel J. Paque, John A. Veil, Ben Grunewald, Paul Jehn,
and Robert F. Van Voorhees

May 2-5, 2005, Hilton Alexandria Mark Center, Alexandria Virginia



The Ground Water Protection Council

- Formed in 1983, the GWPC is the national association of state ground water and underground injection control (UIC) agencies.
 - *Protection and conservation of ground water resources for all beneficial uses*
 - *Safest methods and most effective regulations regarding comprehensive ground water protection and underground injection techniques*



CO₂ Injection is Already Occurring and Will Soon Increase With *Geologic Sequestration*

- In 2004, more than 70 projects in the U.S. injected CO₂ for enhanced oil recovery (EOR), regulated within UIC program
- CO₂ storage wells (UIC) used at some EOR sites
- CO₂ injection is currently ongoing at Weyburn, Frio, Sleipner, and other places
- Within a few years, the universe of CO₂ injection wells will dramatically increase with the advent of CO₂ ***geologic sequestration***



Developing Regulatory Solutions

- State and Federal agencies historically have taken years to develop and implement new or modify existing authorities and regulations
- This process typically involves two stages: Federal development followed by State development and implementation
- Comprehensive coordination and early State involvement can reduce the time for development and implementation



What Are Some Concerns About CO₂ Geologic Sequestration?

- Regulators and injectors have limited experience with CO₂ geologic sequestration. Challenges include:
 - Lower density = greater buoyancy of injectate
 - Reaction with water to form acid
 - Geochemical changes within the receiving formation
 - Damaging effects on cement and metal
 - Keeping CO₂ in desired formations for a sustained time
 - Massive scope of the proposed CO₂ geologic sequestration
- There is no dedicated regulatory program for CO₂ geologic sequestration.



Regulatory Issues for CO₂ Geologic Sequestration

- Siting
 - Geology of injection formation and overlying formations
 - Reservoir pressure profiles and other characteristics
 - Appropriate area of review (well bores, faults, or vertical conduits)
- Well construction
 - Corrosion resistant pipes, casing, and cement
 - Number of casing strings
- Operations
 - Maximum injection pressure (above or below fracture pressure)
 - Injection rate and volume
 - Interactions between injectate, formations, and formation fluids
 - Injection for sequestration/storage vs. use for EOR



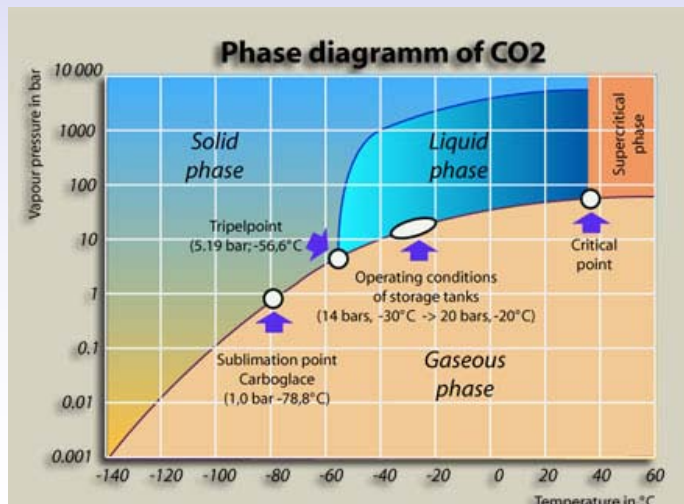
Regulatory Issues for Geologic CO₂ Sequestration (cont)

- Monitoring
 - Mechanical integrity testing
 - How to monitor sequestration area
- Closure
 - Plugging and securing
 - Long term issues
 - Financial assurance
- Legal/Policy
 - Ownership interests in wells, pore spaces, and fluids
 - Long-term maintenance and liability
 - Length of time that CO₂ must be sequestered underground
 - Credit for CO₂ capture/removal from atmosphere
 - Appropriateness of current statutory and regulatory authorities



Regulatory Development Will Address Questions Such As:

- What changes in receiving reservoirs are acceptable?
 - Desalination is now used to treat brine aquifers considered completely unusable for drinking water 10 years ago
- How much CO₂ escape is acceptable?
- What other constituents will be acceptable in the CO₂ injectate?
- Could other chemicals be generated in the formations and in ground water as a result of CO₂ injection?



Consideration of Appropriate Regulatory Programs

- Look at existing regulatory programs
 - How will they protect USDWs?
 - How will they protect human health and the environment?
 - How will they prevent or control CO₂ releases to the atmosphere?
 - Can we adapt existing laws to adequately regulate CO₂ sequestration?
 - Apply reasonable, but not necessarily identical requirements to sequestration/storage wells
 - Weigh overall environmental risks and benefits



Oversight Options for CO₂ Geologic Sequestration

- U.S. EPA
 - Office of Water
 - UIC program
 - New CO₂ program?
 - Office of Air (emission reduction, credit and trading)
- State agencies
 - Environmental
 - Water, public health, air, other
 - Oil and gas
 - Others?
- Blended combinations
 - Allocation of responsibility by state and/or federal agencies



How Can CO₂ Geologic Sequestration Programs Be Sensibly Developed?

- Follow iterative and deliberative process
- Allow for flexibility, innovation, and adaptation
- Provide broad expert participation

US EPA

Industry

US DOE

Academia

State agencies

National labs

Regional Partnerships

International experts

Non-Government Organizations

Other federal agencies

National organizations

Informed members of the public



Steps Forward

- Develop common and comprehensive base of knowledge for regulatory decision makers
 - GWPC will host a regulator workshop in 2005
 - GWPC will survey states regarding regulation of practice
 - EPA workshops on key geologic CO₂ sequestration issues
 - Modeling workshop held in April
 - Risk assessment workshop planned for GWPC 2005 Annual Forum
 - GWPC white paper on geologic CO₂ sequestration regulatory issues and options
 - Public education and communication of potential risks and benefits of geologic CO₂ sequestration
 - Safety and effectiveness of injection and sequestration technology



GWPC Participation in CO₂ Geologic Sequestration Regulatory Development

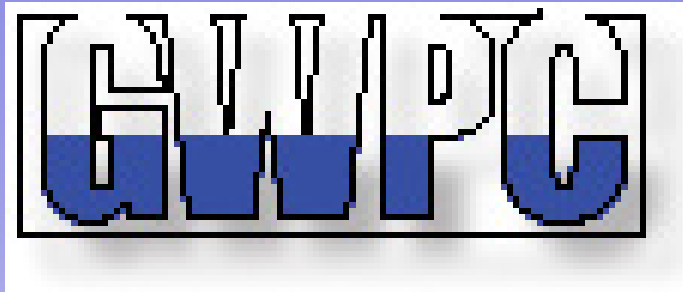
- GWPC provides a respected forum for communication and research on ground water protection and underground injection issues
- GWPC's goal is to support fair and effective development for CO₂ sequestration



Conclusions

- CO₂ geologic sequestration is likely to expand significantly over the next few decades
- Existing federal and state regulatory programs were not specifically designed to accommodate the large number and unique characteristics of CO₂ geologic sequestration
- Regulatory modifications may be appropriate to allow sufficient flexibility to encourage innovation and adaptation
- States have decades of extensive experience regulating diverse underground injection disposal and storage activities while protecting ground water resources
- State and federal partners need to complete the regulatory process in a timely fashion to satisfy the need for geologic sequestration
- Communication and coordination between researchers and regulators is key to geologic sequestration regulatory development





www.gwpc.org

405 516-4972

